Automatic adjustment mechanisms and budget balancing of pension schemes

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Introduction

Preliminary remarks (1)

- In general, governments are reluctant to reform pension systems, fearing that the reforms might induce too high political costs. As a consequence, they tend to procrastinate and to postpone the adoption of measures that would guarantee solvency.

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- Of course, faced with the emergency of the insolvency of their pension systems, all governments have conducted reforms - some of them very substantial - but without setting restoring forces. The problem with *ad hoc* reforms is that, quoting Turner (2009), "(they) have a high degree of political risk because their timing and magnitude are unknown".

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  - Delegate the management of the pension systems to competent independent authorities.
  - Introduce new rules to allow for **Automatic Adjustment Mechanisms (AAM)**. $\Longrightarrow$ guarantee the solvency of the system at any date without needing political intervention and eliminating the "need for large program changes made in crisis mode" (Turner, 2009).

Introduction

Preliminary remarks (3)

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- To reinforce the robustness of the system, it has launched an **Automatic Balance Mechanism (ABM)** that relies on the key rule that every year, the solvency of the pension system must be checked, permitted by the flexibility of the present and future pension benefits (Settergren, 2001). The return of the "savings" invested in the NDC crucially depends on this indexation.

Introduction

Aims of the paper

⇒Characterizing the properties of the **Automatic Adjustment Mechanisms** (AAMs) and proposing a general form of **Automatic Balance Mechanism** (ABM) based on dynamic programming and the **minimization of a loss function**.

- Focus on the social security autopilot by analyzing the contrasted cases of AAM in Canada, Sweden, Germany and Italy, to assess their possible implementation in the U.S.

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- Recall that if **semi-automatic** stabilizing mechanisms have been used in the U.S. for the last forty years, **fully automatic** stabilizing mechanisms (ASM) are more recent.

Introduction

Related literature: Capretta (2006)

- Considers the examples of Sweden and Germany to address the issue of automatic solvency of U.S. social security.

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- Considers the examples of Sweden and Germany to address the issue of automatic solvency of U.S. social security.
- Stresses that, although correcting for longer life spans helps stabilize costs, it is not sufficient to assure solvency at a fixed contribution rate, as fertility and population growth, labor force participation patterns, and productivity growth all play important roles in long term pay-as-you-go financing. As a result, Sweden adopted an ABM, whereas Germany links annual pension indexing to changes in the ratio of pensioners to workers supporting the system, the so-called "sustainability factor".

- Recalls the suggestion by Steuerle and Penner (2005) to start the process of automatic adjustments in the U.S. social security by setting the normal retirement age administratively, taking into account the increase of life expectancy, hence mimicking the Swedish NDC's annuity divisor device. However, according to Capretta, it may be easier for the U.S. to adopt an adjustment factor similar to Germany's "sustainability factor".

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- Insists that Congress would be more likely to adopt a mechanistic provision that guarantees to future generations of retirees the same number of years, on average, in benefits as the current generation - automatically.

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3. Building a "smooth" ABM, assuming a trade-off between present and future receipts and expenditures.
4. Application of our ABM to U.S. Social Security.

The budget constraint of the pension system writes at time t:

$$\underbrace{F_{t-1}}_{\text{Reserve fund}} + \underbrace{\overbrace{r_t}^{\text{interest rate}} \cdot F_{t-1} + \overbrace{\tau_t}^{\text{contrib. rate}} \cdot \sum_a \overbrace{w_{a,t}}^{\text{aver. wage}} \cdot \overbrace{e_{a,t}}^{\text{employ. rate}} \cdot \overbrace{N_{a,t}}^{\text{population}}}_{\text{Total receipts}}$$

$$=$$

$$\underbrace{\sum_a \overbrace{p_{a,t}}^{\text{aver. pension}} \cdot \overbrace{\lambda_{a,t}}^{\text{\% of retired people}} \cdot \overbrace{N_{a,t}}^{\text{population}}}_{\text{Total expenditures}} + \underbrace{F_t}_{\text{Reserve fund}}$$

The intertemporal pension budget constraint

What about solvency (Boado-Penas, Vidal-Meliá and Sakamoto, 2010)?

Accountancy point of view: different methods to estimate the implicit liabilities and the solvency of unfunded pension systems.

In practice, two measures of solvency are used:

- Assessing the discounted sum of revenues and expenditures: used in the United States to estimate the present value of the underfunding of the system.

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- Assessing the discounted sum of revenues and expenditures: used in the United States to estimate the present value of the underfunding of the system.
- Another method is adopted by Sweden (Settergren, 2001). It defines its pension plan is solvent when:

  Present value of contributions payable by workers alive today
  $+$ Value of the reserve fund
  $=$
  Value of pension commitments towards generations alive today.

Automatic rules: adjusting, stabilizing and balancing

Definition

With the AAM, the institutional parameters are adjusted according to the predefined rules. Otherwise, the changes are considered as discretionary decisions. They are therefore subject to the hazards of political choice.

Automatic rules: adjusting, stabilizing and balancing

Definition

Choosing a specific Automatic Adjustment Mechanism requires to define several elements (see Bosworth and Weaver, 2011):

1. Legitimating the rules according to the example "one objective, one tool." We need to identify objectives and tools (parameters). Main objectives concern equity, social justice and solvency.

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4. Setting adjustments as *ex ante* based on expectations (prediction-based) or *ex post* based on the states of nature.
5. Fixing the degree of automaticity (no questioning): the adjustments are mandatory, which guarantees credibility of the process.

- **Benefits index:** For each retiree i, the pension benefit evolves each year as follows: $p_i = I \cdot p_i^-$ where I is an indexing factor. The main objective of the indexing factor is to preserve the level of quality of life. In general, I corrects the increase in the cost of living and permits to maintain the purchase power of the pension.

- **Contributory period:** To obtain a full pension requires to validate a sufficient number of quarters. The duration of the assessment period can be connected to life expectancy. The underlying idea is to guarantee to each generation a similar ratio: time to retire / time worked. In France, the 2003 law induced an automatic revision of the contributory period per generation with respect to changes in the life expectancy.

- **Retirement age ("normal" or minimum):** In many countries, the reforms have modified the law relative to the legal retirement ages. The minimum age is the age at which workers can liquidate their pensions (for example, 61 y.o in Sweden). The normal retirement age is the age which serves as a reference to define the full pension. Generally, the adjustment is not automatic but planned by the law. In practice, with a given frequency, these ages could be revised w.r.t new informations about changes in life expectancy for each cohort.

- **Pension-earnings links:** In Sweden, the coefficient of conversion of capital into an annuity depends on the age and the birth year. This coefficient is revised to reflect the evolution of generation mortality tables. In France, the 1993 reform planned changes in the pension-earnings links by increasing the reference period to compute the life cycle average wage which is used in the first pillar pension scheme to determine the benefit. It is not an automatic adjustment but a planned one. This correction has gradually reduced the pensions of the new generations to retire, which could be interpreted as taking into account the increase in life expectancy at retirement.

What happens if AAM are not sufficiently stabilizing?

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1. How is defined the pension budget balance?
2. What are the criteria for choosing changes in current law?
3. What room is left for optimization?
4. What planning time horizon for full balancing?

Main difficulty: defining a reference horizon and the frequency of the automatic adjustments.

As the AAM, the Automatic Balance Mechanisms can be determined:
- *ex ante*: shocks are anticipated and changes in law are planned.
- *ex post*: the law evolves *w.r.t* to the knowledge of the states of nature.

AAM $\Rightarrow$ Changes of the pension formula parameters and the contribution rate.

Cases where $F = 0$ i.e. budget balance at each period: two simple examples

- For fixed dependency rate (d) and replacement rate (ρ), an automatic adjustment of the contribution rate (τ) gives:

$$\tau = \rho \cdot d. \tag{1}$$

Cases where $F = 0$ i.e. budget balance at each period: two simple examples

- For fixed dependency rate (d) and replacement rate (ρ), an automatic adjustment of the contribution rate (τ) gives:

$$\tau = \rho \cdot d. \tag{1}$$

- For fixed retirement rate (λ_a) and contribution rate, an automatic adjustment of the pension index gives:

$$I = \tau \cdot \bar{w} \cdot \frac{\sum_a e_a \cdot N_a}{\sum_a p_a^- \cdot \lambda_a \cdot I_a \cdot N_a}. \tag{2}$$

where $p_a = I \cdot I_a \cdot p_a^-$ with I the general pension index and I_a an index per age

Cases where $F \neq 0$: the alternatives to automatic adjustment are more numerous and it can be interesting to plan the budget balance on a large number of periods. But the thorniest question is:

How to plan a sequence of changes in pension parameters?

That requires to identify an objective function.

Automatic rules: adjusting, stabilizing and balancing

T periods horizon

- **Japan:** the administration makes predictions every 5 years on a 95-year horizon and computes the intertemporal solvency with respect to this horizon.

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- **Japan:** the administration makes predictions every 5 years on a 95-year horizon and computes the intertemporal solvency with respect to this horizon.
- **U.S.:** Social Security opted for a 75-year time horizon, and the forecasts are published annually. That permits a thorough analysis of the solvency. $\Longrightarrow$ *e.g.* estimate the year when the system reaches bankruptcy. After this critical year, in the absence of corrective measures, the federal government has an obligation to reduce pensions to achieve a financial balance between pension payments and social contributions. **The adjustment is automatic and rough** because the U.S. Social Security does not have the right to borrow.

In search of a balancing smoothing

- We develop a "simple" method.
- The objective function is defined as a quadratic loss function. Quadratic cost functions are commonly used in the analysis of monetary policy (Svensson, 2003).
- A similar approach applied to retirement has been developed by Berger and Lavigne (2007). But their adjustment relates solely to the contribution rate, and the social cost is measured by the square of the change in each period. Moreover, they do not introduce intertemporal discount, which leaves no possibility of procrastination. Here the approach is improved because it leaves two possible adjustment modes: by costs and/or by revenues.

In search of a balancing smoothing

- With ABM, the adjustment should result in incremental changes. Indeed, it is hoped that the AAM lead to sufficient adjustments and they contribute to a better financial balance. The ABM is an ultimate setting that should be expected to be marginal. At each period, the "ideal" timing ought to be:
  - First step: the public planner sets the values of the pension parameters;
  - Second step: she checks the solvency of the pension schemes;
  - Third step: she uses ABM to recalibrate the parameters.
- Of course, it would be naive to think that minimizing a quadratic loss function could be sufficient to capture all the problems related to the adjustment of the pension system. However, the quadratic loss is a way to catch the public will to change smoothly the current legislation.

In search of a balancing smoothing

The value of the loss associated to each period is measured by:

$$LF_t = \alpha \cdot (A_t - 1)^2 + (1 - \alpha) \cdot (B_t - 1)^2 . \qquad (3)$$

where A_t and B_t are two deformation coefficients which modify respectively the present and future payroll taxes and pension expenditures relatively to those established by the current law. This loss function captures the fact that changing parameters is costly (both socially and politically) and that minimizing it means the social planner hopes to limit changes.

In search of a balancing smoothing

The social planner sets a time horizon T to balance the sum of discounted receipts and the sum of discounted expenditures.
The optimizing program is:

$$\begin{cases} \min\limits_{\{\mathbf{A}_t,\mathbf{B}_t\}} \sum_{t=1}^{T} \beta^{t-1} \cdot LF_t \\ s.t.\ \sum_{t=1}^{T} \frac{\mathbf{A}_t \cdot \tau_t \cdot w_t \cdot e_t \cdot L_t}{\Pi_{i=2}^{t} R_i} + R_1 \cdot F_0 = \sum_{t=1}^{T} \frac{\mathbf{B}_t \cdot \rho_t \cdot w_t \cdot d_t \cdot L_t}{\Pi_{i=2}^{t} R_i} \end{cases} . \quad (4)$$

In search of a balancing smoothing

The F.O.C gives:

$$\begin{cases} A_t : \beta^{t-1} \cdot 2 \cdot \alpha \cdot (A_t - 1) = \psi \cdot \frac{\tau_t \cdot w_t \cdot e_t \cdot L_t}{\Pi_{i=2}^{t} R_i} \\ B_t : \beta^{t-1} \cdot 2 \cdot (1-\alpha) \cdot (B_t - 1) = -\psi \cdot \frac{\rho_t \cdot w_t \cdot d_t \cdot L_t}{\Pi_{i=2}^{t} R_i} \end{cases} . \tag{5}$$

where ψ is the Lagrange multiplier.

In search of a balancing smoothing

We identify A_1 and B_1 :

$$\begin{cases} A_1 = 1 - \dfrac{\frac{F_T}{\Pi_{i=1}^T R_i}}{\sum_{t=1}^T \frac{1}{\beta^{t-1}\cdot\left(\Pi_{i=1}^t R_i\right)^2}\cdot\left(\frac{(\tau_t\cdot w_t\cdot e_t\cdot L_t)^2+\frac{\alpha}{1-\alpha}\cdot(\rho_t\cdot w_t\cdot d_t\cdot L_t)^2}{\tau_1\cdot w_1\cdot e_1\cdot L_1}\right)} \\ B_1 = 1 + \dfrac{\frac{F_T}{\Pi_{i=1}^T R_i}}{\sum_{t=1}^T \frac{1}{\beta^{t-1}\cdot\left(\Pi_{i=1}^t R_i\right)^2}\cdot\left(\frac{\frac{1-\alpha}{\alpha}\cdot(\tau_t\cdot w_t\cdot e_t\cdot L_t)^2+(\rho_t\cdot w_t\cdot d_t\cdot L_t)^2}{\rho_1\cdot w_1\cdot d_1\cdot L_1}\right)} \end{cases} \tag{6}$$

In search of a balancing smoothing

and deduce the dynamics of coefficients adjustment:

$$\begin{cases} A_t = 1 + \frac{\tau_t \cdot w_t \cdot e_t \cdot L_t}{\tau_1 \cdot w_1 \cdot e_1 \cdot L_1} \cdot \frac{1}{\beta^{t-1} \cdot \Pi_{i=2}^{t} R_i} \cdot (A_1 - 1) \\ B_t = 1 + \frac{\rho_t \cdot w_t \cdot d_t \cdot L_t}{\rho_1 \cdot w_1 \cdot d_1 \cdot L_1} \cdot \frac{1}{\beta^{t-1} \cdot \Pi_{i=2}^{t} R_i} \cdot (B_1 - 1) \end{cases} \quad (7)$$

In search of a balancing smoothing

This maximizing problem can be completed by adding constraints on the level of the reserve fund ($F_T > 0$ or $F_t \geq 0 \; \forall t$ without debt constraint) or the adjustment parameters.

In search of a balancing smoothing

These results can be interpreted in three ways:

- A_t and B_t can induce practical implications in terms of pension reforms. They define distances to a fixed target in terms of payroll taxes (receipts) and pension benefits (expenditures).

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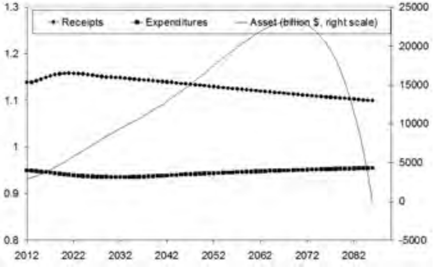
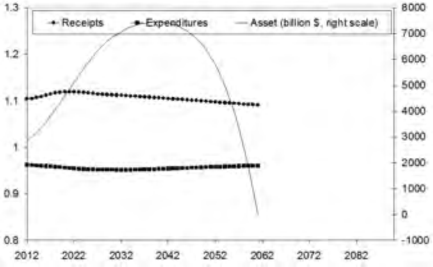
- A_t and B_t can induce practical implications in terms of pension reforms. They define distances to a fixed target in terms of payroll taxes (receipts) and pension benefits (expenditures).
- Measuring A_t and B_t would show how the pension schemes are strongly unbalanced in the long run;
- Revealed preferences: reforms imply changes in legislation. The levels of expenditures and receipts are modified w.r.t a previous scenario without reform. Assuming A_t and B_t to be measured with accuracy would associate public decisions with an implicit function of public preferences.

Sensitivity to time horizon: U.S. Social Security

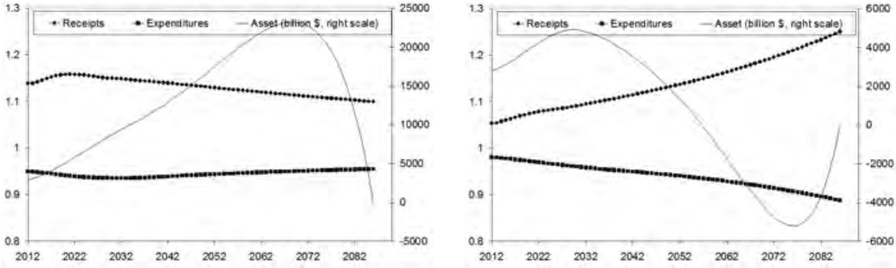


$T = 75$



$T = 50$

$\beta = 1$ and $\alpha = 0.25$

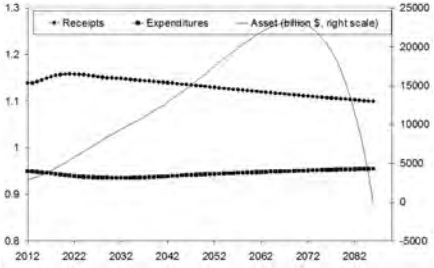


$\beta = 1$ $\beta = 0.975$

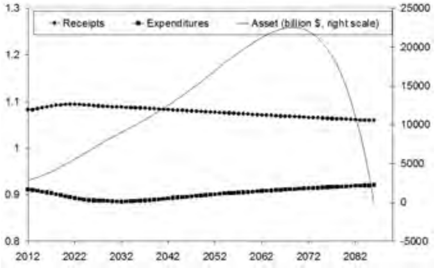
$T = 75$ and $\alpha = 0.25$

Applications of our ABM

Sensitivity to the weigth assigned to receipts: U.S. Social Security



$\alpha = 0.25$



$\alpha = 0.5$

$T = 75$ and $\beta = 1$

Conclusion

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- This article has identified different types of AAM that can be implemented and has shown how they contribute to a better solvency.
- Similarly as in the Swedish pension, we propose to build an ABM starting from a dynamic programming setting. For a given planning horizon, we obtain formulas that determine how at each period revenues and expenses must be adjusted. That allows to consider the ABM chosen by Sweden as a special case.

Conclusion

- Sweden is the only country that strengthens its AAM with an ABM that ensures financial stability. Indeed, the Swedish ABM can be obtained by assuming very high adjustment costs on revenue and choosing a particular concept of measure of solvency.

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- Sweden is the only country that strengthens its AAM with an ABM that ensures financial stability. Indeed, the Swedish ABM can be obtained by assuming very high adjustment costs on revenue and choosing a particular concept of measure of solvency.
- We apply these formulas to the financial balances of the American system. Using dynamic programming avoids brutal adjustments and thus moderates or smooths the marginal adjustments necessary for financial stability.

Conclusion

- However, this exercise of dynamic programming presents a major limit. In effect, the ABM is evaluated in a context where economic variables are assumed to be exogenous. A study of the relationship between the fitting parameters and the evolution of the economy can be a natural extension of this article. From a macroeconomic point of view, OLG-CGE models have been developed to estimate the impact of Social Security reforms in an intertemporal and intergenerational general equilibrium framework. Such models are used to "optimize" Social Security reforms. Furthermore, dynamic microsimulation models give a lot of details on the microeconomic impacts of Social Security reforms.